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BALE PRESS FOR LOOSE MATERIAL

BACKGROUND OF THE INVENTION:

Bale presses have long been known and tested in the field of harvesting machines. For these presses, stalk material, which is to be pressed, is transferred over conveying paths and by conveying means into a filling space and stuffed there with a pivoted press ram into a baling space. The baling space is a provider with tying devices, with the help of which the material pressed is tied up into bales. The course of these processes proceeds with mechanical coupling, the driving mechanism starting out from a central drive shaft.

In addition, there have already been attempts to use systems, which have been tested by harvesting machine, also for stationary presses, such as those for waste paper. This use accommodates especially also the tying technique with tape knotters, which was developed for harvesting machines and manufactured on a large scale. In this case, the tape is no longer brought together through the stalk material to the knotter, as is customary with harvesting machines with stalk material that can be pierced well, but must be inserted by the piston, avoiding the material being pressed. This is not a problem in the case of a small and light construction and a piston with wide openings and low working forces, as in the case harvesting machines.

On the other hand, waste presses for industrial requirements are stationary and work with very high forces and are to be designed for breakdown-free continuous operation. At the same time, wire ties are generally provided, for which thick wires are uncoiled from rolls and, during the completion of a bale and optionally also at the start of a new bale, are connected to one another by twisting.

However, it has turned out that the wire material interferes with the further processing of the material compressed and, moreover, requires expensive and critical working steps for its elimination. For example, during the comminution or wet processing of waste paper, cut wire residues can stop or even damage the processing machines. Already during the transport and storage of the bales, protruding, twisted and terminally cut wire ends interfere and are hazardous.

SUMMARY OF THE INVENTION:

Sub a1

Pursuant to the invention the knot technique can also be used for large industrial presses with a high output. In this connection, it is very important to construct the openings in the press ram in the form of tailor-made channels which, on the one hand, do not form any dead corners and regions, into which the material being pressed can penetrate and, instead, are "swept" by the supplying arms of the knotters and, on the other, with outlet slots at the front for the tying material, enable the die to be retracted after the binding and nevertheless, in contrast to the wide open regions, customary with conventional bale presses working at a low pressure and a low output level, make provisions so that the openings reduce to slots and, with that, are secured as

far as possible against penetration of material being pressed and that also the high compression forces are applied with a0 press ram surface, which remains as large as possible.

With that, the knotter technique can also be used with flexible tapes for large presses. It has turned out that these tapes are not in any way inferior in strength, as was previously assumed, to the wire ties. A critical testing in this respect has shown that wire ties, due to the strength of the wire, can absorb high loads. However, the twists represent weaknesses with a much lower load-carrying capacity and represent a need for safety reserves, with which very limited values result. In the case of flexible tying material and a knotting technique, very high strengths can be realized for the tying material as well as at the knot, these results being obtained with little sacrifice of safety. As far as the strength of the girding is concerned, a pressing need for the use of wire girding can no longer be maintained.

A large number of non-metallic fibers of textile or plastic materials, which satisfy the requirements that must be fulfilled here, are available on the market as tying material. Especially for girding waste paper bales, there are even tying materials, which cannot be undone but dissolve when wet, or even tying materials with a fine and short form for recycling or tying materials on a paper basis, which do not have to be removed in a subsequent recycling process and, instead, can be used as starting material for the recycled product.

Such a bale press can then be operated in the manner already customary with large hydraulic presses with wire ties in a sequential sequence of pressure medium-actuated movements,

for which the knotter function is initiated only at the conclusion of a pressing and lifting motion of the press ram, which completes a bale, and the supplying arm passes through the press ram only when the latter is stationary. With that, additional opening spaces in the piston can be avoided, which would otherwise be necessary for mechanically coupled and mutually overlapping motions of the ram and supplying arm of agricultural machines.

For the tape loops, which are to be provided for girding a bale, basically a single knot per tape loop is required, so that the tape loop consists altogether only of a one-piece section of tape. This technique has the advantage that only one knot has to be produced, so that, when the knot is specified with a residual uncertainty with respect to its durability, only one uncertainty place remains. However, this technique had the disadvantage that after the knotting and cutting, the free end of the tying material must be held at the knotter for the subsequent bale and, when forming and pushing in a new bale, the tape must be shifted gradually at the periphery of the bale in accordance with the growth of the latter. This leads to large movement of the tape relative to the bale and also to critical loads.

In accordance with an alternative tying technique, the tying material is pulled off in two strands from two mutually opposite rolls of similar supplies and the knotter produces a knot before and after each cut. One of these knots closes the girding for the finished bale and the other connects the two new open strands into a loop. This loop and the two strands can run along with the bale as it grows without any shifting relative to the bale worth mentioning.

An example of the invention is described in greater details in the following and shown in the accompanying drawings.

IN THE DRAWINGS:

Figure 1 shows a vertical section through a channel track press, and

Figures 2 to 7 show horizontal sections through the channel press of Figure 1 for different situations of the tying process.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Sub a2

The channel bale press, which is labeled 1 as a whole in the drawing, is shown in each case only in a central region with a portion of a filling shaft 2 over a filling space 3 below and the adjoining part of a press channel, a press ram with an associated piston 6 of a hydraulic actuator being in the advanced position in the filling space 3 and in the inlet of the press channel 4, where it holds a finished but not yet tied bale 7 under compression, while a previously finished and already tied bale 8 is in the press channel as "abutment" for the bale 7. The construction, described up to now, corresponds to conventional industrial bale presses with hydraulic driving devices and an unwinding technique based on wire windings.

In the present case, however, the bales are held with a tape-shaped flexible tying material, so that the textile bales 8 are fixed with three girdings 9, which lie on top of one another, while the bales are not yet tied but are already bordered on three sides by three open tape loops 10.

Sub a3

For closing these tape loops, in each case, one of two strands of the tying material on either side is passed through the press ram to the other strand. For this purpose, the press ram has channels 11, which extend horizontally here to fit in with the horizontal tying. It is self evident that the alternatively possible vertical tying would lead to vertical channels. The channels are fitted tightly to the space required by three supplying arms 12 and, in a front press ram surface, end in slots 14, which offer the smallest possible width for the entry of material, which is being compressed, into the press ram 5.

As is evident from the horizontal sections of Figures 2 to 7, the depth of the respective channel is also adapted to the movement profile of the supplying arm 12, in order to avoid "dead corners", in which compressed material can otherwise easily be deposited and consolidated at high loads and during continuous operation and, with time, easily lead to operational malfunctions, which are also difficult to deal with. The channel 11 accordingly is determined by the supplying arm 12, which moves back and forth through the channel 11, carrying out a circular motion about an axis 15. At the same time, penetrating material, such as leaf-shaped paper, is pushed out to the one side or the other. In this respect, the press channel 11 still has a terminal expansion 16 relative to the circular contour, in order to facilitate ejection of the pressed material from this region.

Sub a4

The supplying arm 12 has a sickle shape, with which it can be moved largely in the longitudinal direction through the channel 11. It is actuated over a two-arm lever 17 by a from a hydraulic pressure medium-driving mechanism 18 outside of the press channel.

Sub a5

The tape is supplied to the press channel 4 from two sides and, moreover, in each case from one of two rolls 20, 21 over one of two adjustable friction guides 22, 23 as yarn brakes for maintaining a yarn tension by friction, which then run together over elastic guides 24, 25 and suitable deflections on the one hand through a guide 26 of the supplying arm 12 and, on the other, through a knotter 27 about the new bale 7 up to a knot 28 to form a loop. An adjacent knot 26 An adjacent knot 29 at the already finished bale 8, in conjunction with the rolls 20 and 21, which are present in duplicate as a supply of tying material, shows that two knots per cut, one on each side, must be produced, in order to ensure that the tape can be supplied easily on both sides.

The idle position of the knotter 27 and the supplying arm 12, shown in Figure 2, normally is maintained during several compressing lifts of the press ram 5 which, with every lift of the die, adds to a partial bale until a complete bale having a specified minimum length is obtained. At the same time, the tape loop 30, closed at the knot 28, moves according to the completion of the bale 7 as far as the starting position for knotting, which is shown.

Sub a6

Figure 3 then shows how the supplying arm 12 with a strand 31 of the tape loop 30, which lies on the outlet side of the supplying arm 12, is swiveled through the piston 5 and, at the same time, has brought together this strand 31 in the region of the knotter 27 with an opposite strand

32 of the tape loop 30. With a rotating and pulling-through motion of the knotter, the loop 30 is closed in the form of a knot 33 and severed from the supply rolls 20 and 21 behind the knot, the ends of the tying material being held together and also knotted (Figure 5), before the supplying arm 12 returns to its starting position (Figure 7). The new loop 34, which is held by the new knot 25, is held tightly by the elastic guides 24 and 25 as the supplying arm 12 is retracted.

The structure of the knotter and the knotting process do not have to be discussed completely in detail, since a basic technique is involved here, which has been known and tested in different variations for a long time, especially in the area of harvesting machines. In harvesting machines, there is a central continuous driving mechanism, which moves the participating functioning elements in tight, rigid coupling with one another. It is essential for the actuation of different driving mechanisms, for which provisions are made here, that it is possible to achieve as reliable a driving mechanism as possible even at high press pressures and for material, the compressing properties of which are critical, it being possible to coordinate the starting times and duration of the different courses of motion separately.

Sub a7

As shown by means of Figure 4, the two strands 31 and 32 are to be nestled closely together in a region in which the new knot 32 is to be formed. For this purpose, a yarn presser 36, which initially appears in cross view in Figure 2, swivels about an axis, which extends parallel to the plane of the drawing, and shifts the adjacent end of the strand 31 to the strand 32. However, this contacting movement does not take place in the temporal interplay with the movement of the supplying arm 12 as it does in the case of one of the coupled movements of

harvesting machines. Instead, it takes place at a later time. What matters is that the supplying arm 12 as it moves forward through the channel 11, ejects all foreign material that may have entered the channel 11 and also reaches its end position, before the knotting with the contacting movement of the contactor 36 is initiated.

The exceedingly complex but known and fully developed movements in the knotter 27 are brought about by a control disk 37 with suitable control cams, which act on a knotter mechanism 38 (not shown in detail), which is provided with appropriate fingers. As a result of these movements, the two strands on the supplying side of the tying yarn are taken hold of and held together, cut off up to the knot region and knotted with one another there.

In order to close the free ends of the end yarn, which initially are held together unknotted in the knotter 27, into a new loop, in which these are connected by the second knot 32, the supplying arm 12 initially creates the free movement space of Figure 6, in that it returns out of the piston 5 into its starting position. For knotting, not only the cut ends of the tying material but also the adjoining regions must be brought closer together, in order to have the tying material approximately parallel for the knotting. For this purpose, a tape rocker 39 at the knotter 27 moves so that the yarn strand, unrolling from roll 21, is pressed with the help of a contacting roller 40 against the yarn strand unrolling from the roll. At the same time, the yarn presser 36 is swiveled along once again with the yarn rocker 39 for the second knot, in order to bring the two ends of the tying yarn together. These movements also are specified independently of time and in a sequence, which is directed to the reliability of the knotting. For this purpose, the yarn rocker

39 is swiveled by an actuator 41, operated by a pressure medium, after the supplying arm 12 has concluded its movement. The later is also actuated independently and moreover the pressure medium actuating drive 18.

An operation with hydraulic actuators is advantageous for converting the harvesting machine tying technique. In this respect, it is advantageous for the coordination and the adaptation of the exceedingly critical press ram region, if the press ram remains stationary and does not carry out a continuous movement about its front dead center, when the supplying arm goes to the knotter, as is customary in the case of harvesting machines. A careful coordination of the piston openings with the movement profile of the supplying arm can be achieved here. At high outputs and high compression forces, it is also important to ensure that the piston remains stationary in its front end position and, at the same time, keeps the finished bale under pressure and does not return back over its dead center position already during the tying process.

However, it has been observed that this technique can be used advantageously in the area of industrial, heavy and stationary hopper bale presses and especially in channel bale presses, if the requirements of the material being pressed, such as waste paper, can take into account the high press forces and the continuous operations by a special configuration of the binding region.